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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/632,825	08/04/2003	Yun-Jung Lee	9862-000016/US	9195
30593	7590	02/28/2005	EXAMINER	
HARNESS, DICKEY & PIERCE, P.L.C.			PERT, EVAN T	
P.O. BOX 8910			ART UNIT	
RESTON, VA 20195			PAPER NUMBER	
			2826	

DATE MAILED: 02/28/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

AK

**Office Action Summary**

Application No.

10/632,825

Applicant(s)

LEE ET AL.

Examiner

Evan Pert

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**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --****Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 04 August 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-22, 25 and 26 is/are rejected.
- 7) ☒ Claim(s) 23 and 24 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 04 August 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \*    c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |                                                                                                    |                                                                             |
|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                        | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)               | Paper No(s)/Mail Date. _____                                                |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>0803</u> .                                                                | 6) <input type="checkbox"/> Other: _____                                    |

## **DETAILED ACTION**

### ***Specification***

1. Regarding paragraph [0001], applicant's intent to incorporate the Korean Patent Application "in its entirety" is acknowledged.

If applicant is merely claiming priority to a foreign application under 35 USC 119, then [0001] is redundant to field "[30]" of a patent, priority being stated in the oath/declaration.

If applicant is also attempting to incorporate subject matter not disclosed in the US application, the examiner requires an English translation of the material not included in the US filing, for review.

Applicant may delete [0001] while still claiming priority (since a claim to foreign priority appears in field [30] of a patent), or may provide an English translation of material being "incorporated in its entirety," that is not part of the US application.

2. At [0079], "TEDAH" should read --TDEAH--.

### ***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1-14 and 26 are rejected under 35 U.S.C. 102(e) as being anticipated by Metzner et al. (US 2003/0232511 A1).

Regarding claim 1, the claimed "exposing" and "oxidizing" steps are disclosed, for example, at [0011] of the Metzner et al. reference, as an "ALD" process using a precursor of "TDEAH" that forms a chemisorbed precursor layer on the substrate, which is subsequently oxidized with "ozone" or "oxygen radicals" to form "hafnium oxide." "TDEAH" inherently includes an "amino functional group," by its definition (e.g. per [0018] of the specification).

Regarding claims 2-4, in the Metzner et al. reference, the "M" is "hafnium" ([0019], [0020]) and "X" represents "-NR<sub>1</sub>R<sub>2</sub>" wherein R<sub>1</sub> and R<sub>2</sub> are independently selected from a group consisting of hydrogen and alkyl groups [0020].

Regarding claim 5, the "most preferred" is "TDEAH" [0020].

Regarding claims 6-7, an exemplary "oxidant" is "ozone" (i.e. O<sub>3</sub>) [0022].

Regarding claim 8, the steps added to limitations of claim 1 addressed above merely add aspects to the scope of claim 1 that are *implied* by "ALD" of "semiconductor films such as high k gate dielectric layers or high k capacitor dielectric layers" [0011]. The linguistically claimed steps of claim 8 that are implied are also *conceptually* disclosed at [0006] with [0011] taken with [0019] to [0022].

Regarding claim 9, the "most preferred" precursor is "TDEAH" [0020].

Regarding claims 10 and 11, an exemplary "oxidant" is "ozone" (i.e. O<sub>3</sub>) [0022].

Regarding claim 12, the reference to Metzner et al. anticipates values among the ranges that are claimed because the reference discloses "between about 150°C and 220°C" with a pressure of "from 0.1 to 10 Torr" [0021], and the precursor gets introduced into the chamber using a carrier gas such as nitrogen or argon (the nitrogen and argon inherently being "inert") [0021].

Regarding claim 13, as is a definition of "ALD," the "deposition" and "purge" are repeated as "cycles" [0022].

Regarding claim 14, the "removing" step is anticipated by the Metzner et al. reference, conceptually embodied as language that concludes: "the purge gas need only last long enough to clear the excess TDEAH from the chamber" [0021].

Regarding claim 26, "TDEAH" is an exemplary precursor that falls within the scope of this genus claim, by applicant's own disclosure, for example [0018], and the Metzner et al. reference finds "TDEAH" to be the "most preferred" [0020].

### ***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 15-22 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Metzner et al., as applied to claims 1-14 and 26 above, and further in view of Basceri et al. (US 6,753,618 B2).

While the drawings in the Metzner et al. reference include capacitors and other depictions, the examiner does not particularly rely on any drawings in the Metzner et al. reference, as they are misplaced drawings, not corresponding to the text of the disclosure of Metzner et al. (e.g. descriptions [0012] through [0018] clearly do not correspond to the Figures).

Since Metzner et al. does not explain any of the drawings that are misplaced, the material in the drawings is not a proper disclosure to be relied on by the examiner. The Metzner et al. reference is relied on only as saying that the ALD disclosed (using TDEAH with ozone to form hafnium oxide) is suitable for forming "semiconductor films such as high k gate dielectric layers or high k capacitor dielectric layers" [0011].

Regarding claims 15 and 25, therefore, with the above explanation, the portion of the Metzner et al. reference properly relied on is silent about any particular way of *how* to make a capacitor, but does disclose that the hafnium oxide formed by the inventive method is good as a capacitor dielectric, which means that the Metzner et al. reference motivates one of ordinary skill in the art to use the method to "form a capacitor".

As a chosen example, Baceri et al. discloses methodology for making capacitors as part of semiconductor devices [abstract], wherein a first electrode (62) is formed on a semiconductor substrate (13) (i.e. the claimed step a), forming a capacitor dielectric (80) (ALD, but different than that of the claimed steps b and c), and forming a second electrode on the dielectric layer (90) (i.e. the claimed step d).

It would have been obvious to one of ordinary skill in the art at the time of the claimed invention to adopt the method of forming hafnium oxide as a capacitor dielectric disclosed in the Metzner et al. reference as the capacitor dielectric (80) in the Basceri et al. reference, thus adopting the claimed steps b and c as they are discussed in the rejection of claim 1.

One of ordinary skill in the art would have been motivated to adopt the hafnium-oxide-capacitor-dielectric forming-method disclosed in the Metzner et al. reference to form capacitor dielectric (80) disclosed in the Basceri et al. reference because the method of the Metzner et al. reference, unlike anything disclosed in the Basceri et al. reference, can produce a high k capacitor dielectric that does not contain detectable amounts of carbon [0039] wherein the carbon is unwanted [0007].

Regarding claims 16 and 17, in adopting the method of Metzner et al. in the device of Basceri et al. as stated for the rejection of claim 15, one would use "TDEAH" as the "most preferred" and would use "ozone" as an exemplary oxidant for reacting the precursor during an ALD cycle.

Regarding claim 18, the claimed aspect ratio of "at least 10:1" is not specifically stated in the Basceri et al. reference, yet the Metzner et al. reference explains that "aspect ratios of 10 or greater are contemplated" [0005], so it would have been obvious to one of ordinary skill in the art at the time of the claimed invention to make the basceri et al. capacitor (100) aspect ratio greater than 10:1, motivated to put more capacitors in a smaller area of integrated circuit chip, and being able to coat the feature having such

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a high aspect ratio by the ALD process using hafnium oxide with TDEAH and ozone as disclosed by the Metzner et al. reference [0005]-[0006] (see MPEP 2144).

Regarding claims 19 and 20, in adopting the method of Metzner et al. to form dielectric (80) in Basceri et al., the first electrode is a multi-layer of doped polysilicon (62) and metal nitride (70), for example.

Regarding claim 21, in adopting the method of Metzner et al. to form dielectric (80) in Basceri et al., the second electrode is a metal nitride (90), for example.

Regarding claim 22, the Metzner et al. reference implicitly discloses the claimed steps b-e in that ALD cycles are repeated using TDEAH as a precursor and ozone as an oxidant such that one complete ALD cycle corresponds to the claimed steps b-c and a second cycle depositing another layer to thicken the hafnium oxide corresponds to claimed steps d-e [0006]-[0011]. Therefore, the claimed steps b-d are practiced for forming the hafnium oxide capacitor dielectric (80) in Basceri et al. more than one atomic layer thick in accordance with the method of Metzner et al., with the electrode formation of steps a and f corresponding the formation of electrode 62/70 and electrode 90 in Basceri et al.. For this rejection, the "first precursor" and the "second precursor" are the same type, but are introduced during different cycles [with claim 23 clearly limited to the "first" and "second" precursors being "different" types, not just different times of use].

### ***Claim Objections***

6. Claims 23 and 24 are objected to because they refer to antecedent "oxide dielectric layers" as "metal oxide layers." Appropriate correction is required.



***Drawings***

7. The examiner requires an explanation or correction of Figs. 8A through 8E that depict "102" as a block under what looks like a transistor gate line to the right of the transistor that has gate dielectric delineated by "104." It seems that the figure is ill drawn, or the cross-section of the line to the right of the gate delineated "104" is actually not a gate. There does seem to be some drawing problem here (unrelated to the claimed invention) in that the specification explains: "an active region and a field region 102 are separately formed." But the region 102, if a field region it totality, as drawn, would not create a channel under the line 106 to the right of 116a. If the structure with 106 to the right of 116a is a line, it seems that leakage current could develop where 116a meets the 106/104, yet the examiner is not sure.

Correction(s) and/or explanation of Figs. 8A though 8E is/are required.

***Allowable Subject Matter***

8. Claims 23-24 are objected to as being dependent upon a rejected base claim, and for linguistic informalities, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

9. The following is a statement of reasons for the indication of allowable subject matter:

The prior art does not disclose or suggest a method of making a capacitor using ALD to form the capacitor's dielectric, wherein the dielectric is formed by steps using a first precursor including an amino functional group and a second precursor including an amino functional group, wherein the first and second precursors are different types of precursors [claim 23], particularly forming a composite layer with a sub-layer of  $\text{Al}_2\text{O}_3$  and a sub-layer of  $\text{HfO}_2$  [claim 24].

### ***Conclusion***

10. The reference "IC Knowledge LLC" made of record and not relied upon is considered pertinent to applicant's disclosure. This 2004 document downloaded from the world wide web does not constitute prior art in itself, but does provide a good explanation of prior art ALD of dielectrics using a halogen rather than an amino functional group, does include "TEMAH" as a precursor (per Table 1), and references several publications which could constitute prior [p. 6, entitled "References"].

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Evan Pert whose telephone number is 571-272-1969. The examiner can normally be reached on M-F (7:30AM-3:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on 571-272-1915. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ETP  
February 18, 2005



**EVAN PERT**  
**PRIMARY EXAMINER**